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A Test of Invariance of the Construct of Suicidal Ideation Across Three Diverse Samples

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Introduction

A significant portion of the American population experience suicidal ideation (SI): in 2020, 15,200,000 Americans reported serious thoughts of suicide in the past year (SAMHSA, 2021). SI is considered an important risk factor for suicide, and it is a distressing experience in and of itself (Jobes & Joiner, 2019). Yet, there is not one universal definition of SI. Furthermore, SI is often not the primary focus of suicide research. Rather, many researchers focus on behavior as an observable phenomenon and include SI as a secondary outcome that often does not improve more than a control condition (e.g., Brown et al., 2005; D'Anci et al., 2019; Nuij et al., 2021; Rudd et al., 2015). Predicting and preventing suicide requires a comprehensive understanding of the construct of suicidality, which includes SI.

Several definitions of SI have been developed. Within routine clinical practice, SI is functionally operationalized as a binary construct (presence or absence) but is considerably more complex. SI has been defined as "[p]assive thoughts about wanting to be dead or active thoughts about killing oneself, not accompanied by preparatory behavior" (O'Connor et al., 2013, p. 85). In developing the Scale for Suicidal Ideation (SSI), Beck et al. (1979) described SI as "plans and wishes to [die by] suicide" (p. 344) that vary along dimensions of intensity, pervasiveness, and intent. The high prevalence of SI and the fact that certain interventions specifically impact SI distinctly from suicide attempts (e.g., CAMS; Jobes, 2016) call for thoughtful attention and empirical clarification to establish SI as a valid construct independent of behavior.

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We propose three defining characteristics of SI and discuss some considerations of what it may not be. First, being ideation, it is a cognitive mental representation. This may be in the form of words or images and can be expressed or endorsed directly or inferred. Second, being about suicide, it has to do both with dying and with killing oneself. An idea just about dying is death ideation, not SI (O'Carroll et al., 1996). Third, simply thinking about suicide is not SI. To be SI, the thought has to be personal and at least somewhat desirable to that person. Suicidal wishes/desires, intentions, and plans fit these three criteria: they involve cognitions, are related to killing oneself, and imply personal motivation. In contrast, neighboring phenomena such as thoughts that life is not worth living or hopelessness do not fulfill these three criteria.

As an internal experience, researchers and clinicians concerned with assessing and predicting SI face the challenge of establishing the validity of this abstract construct. From an ontological perspective, the validity of any construct, or attribute, depends on the "existence of an attribute that causally influences the outcome of the measurement procedure" (p. 1062). As such, theory and measurement validation are simultaneously important, and "construct validity is comprehensive, encompassing all sources of evidence supporting specific interpretations of a score from a measure as well as actions based on such interpretations" (Strauss & Smith, 2009, p. 7). Here, we briefly consider validity evidence for SI.

With regard to content validity (all aspects of a construct are assessed), items across suicide assessment measures commonly include the range of SI dimensions, such as frequency, duration, controllability of acting on suicidal thoughts, and attitudes towards suicide (e.g., acceptable, likely). Given that the dimensionality of a construct informs its content validity, it is necessary to note that two dimensions (Motivation/Desire for Suicide and Preparation for Suicide) are commonly indicated from suicide assessment measures, including the SSI (Brown, 2001); although some measures cover only a single dimension (Batterham et al., 2015). This raises the need to systematically evaluate the number of dimensions to inform SI measurement.

The need to clarify the central content is also evident in the growing literature on using ecological momentary assessments (EMA) of SI. Due to the nature of EMA, fewer items are selected to limit participant burden. The optimal number and form of items to select remains an empirical question. In a systematic review of 35 EMA studies of suicidal thoughts and behaviors, SI assessments differed in the wording of SI items, the number of items (ranging from 1 to 9) and the response format (dichotomous vs. Likert-type) (Sedano-Capdevila et al., 2021). Although a general item related to thinking about killing oneself (e.g., "I thought about committing suicide") was most commonly used, many studies used other items focused on passive SI (e.g., reasons for living/dying), urges to die (by suicide), intentions to die (by suicide), desire to die (by suicide), wish to die (by suicide), or ability to resist the urge to kill oneself. The lack of consistency in the items selected, as well as limited attention toward the psychometric basis for these choices, is concerning (for an exception, see Forkmann et al., 2018). Research is needed to delineate which items are most central to capture the construct of SI in both momentary and retrospective assessments.

Other forms of validity, specifically criterion (how well the measure predicts a specific outcome), concurrent (how well the measure predicts another related variable), and discriminant (whether the measure is associated with unrelated variables in expected ways), are clearer when considering SI measures. Criterion validity has been demonstrated through the ability to discriminate between suicidal and depressed outpatients (Brown, 2001). Concurrent validity is shown through significant correlations with measures of depression, hopelessness, and psychache (Troister & Holden, 2010). Convergent validity is supported by evidence that measures of SI correlate robustly with each other (Batterham et al., 2015; Brown, 2001). Discriminant validity has been supported by an expected low and nonsignificant association of SI scores with measures of capability for suicide (Chu et al., 2017). Taken together, these findings provide support for measures of SI across multiple forms of validity.

Nonetheless, we question whether these forms of validity are sufficient. As noted by Strauss & Smith (2009), "[f]or scientific clinical psychology to advance, researchers should study cohesive, unidimensional constructs" (p. 15). Furthermore, Borsboom and colleagues (2004) state that measurement invariance assumes validity. For these reasons, we sought to evaluate the construct validity of SI by examining the coherence of SI items across measurement tools, time frames, and samples. Our purpose was not to test a new measure of SI (i.e., test construction), instead we sought to examine rather whether the construct of suicidal ideation operates in the way expected (theory validation). Parallel coherence in items assessing SI would support the view of SI as a unified, measurable construct worthy of attention. In addition, we consider the concurrent validity of these items against related items across measurement tools, time frames, and samples.

To test the coherence of SI items, we focused on three aspects of SI related to the motivation or desire for suicide commonly assessed in clinical practice and research: (1) diminished wish to live, (2) urge to die/controllability, and (3) intent/expectation of making a suicide attempt. Although these three items do not reflect the entire spectrum of SI, nor do we consider them necessarily the most central items, each has demonstrated evidence of validity. For example, an index of the difference between participants' wish to die and wish to live significantly predicted suicide (Brown et al., 2005). Similarly, controllability of SI correlated significantly with suicide attempts and plans (van Spijker et al., 2014). Finally, thinking about taking one's life and thinking it possible that one might kill oneself were each related to subjective suicidal intent (Watson et al., 2001).

Current Study

To assess the construct validity of SI, we compared three samples that completed assessments of SI and related constructs. Two samples completed measures as a single, retrospective report recounting the past 7–14 days, whereas one sample completed measures as repeated, momentary assessments. Two studies relied on self-ratings, and one used interviewer-ratings. Samples differed on current SI severity and demographic characteristics. We examined the invariance of a latent construct of three items assessing SI (diminished wish to live, urge to die/controllability, and suicide intent/expectation) and their concurrent

validity against four related items (agitation, burdensome, hopelessness, and fatigue). Our aim was to provide evidence of a consistent SI factor to support construct validity.

Method

Study procedures for each of the three studies were approved by each institution's Institutional Review Board before data collection began. All participants provided written informed consent.

Participants/Procedures

Across studies, participants included 314 adults who completed measures while on psychiatric inpatient units. Demographic and clinical information for each study is reported in Table 1.

Study 1 (Rogers et al., 2019).—Participants were 167 adults who were approached to participate after having been hospitalized for at least 24 hours to ensure stability.

Study 2 (Mandel et al., 2022).—Participants included 114 adults who had made a suicide attempt within 14 days of participation ($n = 57$) or reported SI as part of their presenting problem to the hospital but no past-year suicidal behavior ($n = 57$).

Study 3 (NCT03950765, PI: Kleiman).—Participants included 25 adults hospitalized due to suicidal behavior or severe SI who had access to a smartphone and enrolled in a clinical trial designed to teach adaptive ways to manage emotions. Participants were asked to complete up to six brief smartphone-based EMA surveys each day for the duration of their inpatient stay plus 28 days. This yielded a total of 2,427 surveys. We wanted to match the sample size with the other studies, so we chose four responses per participant at random, leading to 100 total responses used in analyses. In order to keep the analyses based on these data consistent with the other samples, we did not conduct multilevel analyses that incorporated any nesting structure. This did, of course, create between-person compatibility across samples with the loss of some meaningful within-person variance (*ICCs* for the variables included here ranged from .45 to .71).

SI Items

Overview and item selection.—Current SI was assessed using different measures for each study: the self-report *Beck Scale for Suicidal Ideation* (BSS; Beck & Steer, 1991) in Study 1; the interviewer-administered *Scale for Suicidal Ideation* (SSI; Beck et al., 1979) in Study 2; and a set of items used in prior EMA studies (Kleiman et al., 2017) in Study 3. BSS/SSI items were rated on a 0–2 scale, while EMA items were rated on a 0–10 scale. Because Study 3 had the fewest items, we began with those items and came to a consensus on the best corresponding BSS/SSI item, recognizing this is a subjective decision and some items may not perfectly correspond (see Table 2 for specific matches). Other plausible item matches (e.g., BSS/SSI item 2 "wish to die" matched with EMA item "ability to resist the urge") generally yielded parallel findings as our final item pairing.

Concurrent Validity Items

Overview and item selection.—We selected items we expected to show an association with SI based on theory and research (e.g., Interpersonal Theory of Suicide; Van Orden et al., 2010). Studies 1 and 2 used a self-report measure of depressive symptoms rated on a 0–3 scale (*Beck Depression Inventory-2nd Edition*, BDI-II; Beck, Steer, & Brown, 1996), and Study 1 also used a self-report measure of burdensomeness rated on a 1–7 scale (*Interpersonal Needs Questionnaire*, INQ; Van Orden et al., 2012). Study 3 used momentary assessments of affective states rated 0–10. We used a consensus decision-making process to arrive at the best equivalents across studies (see Table 2 for specific matches).

Data Preparation

To facilitate comparison of data across samples, data were normalized to place the values on a common scale using the *rescale min-max* function of the *scales* R package (Wickham & Seidel, 2020) to rescale the values to the range of 0 to 1.

Analytic Strategy

We examined measurement invariance in two stages, first assessing a measurement model and then building a full structural model. Across all models, we used the standard Hu and Bentler (1999) fit metrics: CFI > .95, TLI > .95, RMSEA < .06. The measurement portion of all models used an anchor variable set to 1 (“wish to live”), and we report standardized loadings where appropriate.

Measurement model.—We examined measurement invariance in the measurement model by comparing four hierarchical multi-group structural equation models (SEMs) in *lavaan* (Rosseel, 2012):

1. *Configural invariance* tested whether the factor structure was equivalent across samples (no constraints were applied),
2. *Metric invariance* tested whether factor loadings were invariant across samples,
3. S*calar invariance* tested whether factor loadings and intercepts were invariant across samples,
4. *Strict invariance* tested whether residual variances were invariant across samples.

We compared these nested models using the *lavTestLRT* function, which provides a chi-square that compares the model with more constraints (and higher degrees of freedom) to the model with fewer constraints. Thus, we compared models hierarchically: (a) configural to metric, (b) metric to scalar, and (c) scalar to strict. A nonsignificant chi-square test indicated measurement invariance. We continued this test until we reached a significant chi-square test to determine the specific type of invariance present. We did not examine partial measurement invariance since we had only three indicators.

Structural model.—We used measurement model results to inform the structural model that tested the relationship between SI items and items assessing agitation, burdensome, hopelessness, and fatigue. We specified the same invariance in the measurement portion of

the model that we found in the prior step. We then tested nested structural models with the equivalent constraints to the measurement invariance approach. Specifically, we tested the scalar measurement model with (1) no constraints on the structural model, mirroring configural invariance, (2) constraints on the factor loadings and covariances, mirroring metric invariance, and (3) constraints on the factor loadings, covariances, and intercepts, mirroring scalar invariance. We did not test for strict invariance because the comparison between metric and scalar invariance was significant and strict invariance is often not seen as a required component for assessing measurement invariance (Van De Schoot et al., 2015).

Results

Descriptive Statistics

Samples (see Table 1) differed significantly on several demographic variables, including age, gender, race, and ethnicity. Additionally, Study 2 participants endorsed greater current SI severity and were more likely to endorse previous suicide attempts than did those in Study 1 (this information was not collected for Study 3).

Table 2 displays means of each variable across samples. On the SI items, Study 2's values were greater than Studies 1 and 3, and Study 1's values were greater than Study 3. On the concurrent validity items, Studies 1 and 2's values were greater than Study 3.

Correlations are shown in Table 3. In the combined sample, all variables were significantly correlated. The pattern of correlations within each study varied somewhat, but most correlations were significant, and all were in the same direction.

Measurement model

Table 4 shows the comparisons of the four multi-group SEMs. We observed scalar but not strict invariance across the samples. The model with scalar invariance had acceptable fit (CFI = .969, TLI = .965, RMSEA = .076), supporting the idea that the three SI items consistently loaded onto a SI construct across samples.

Structural model

Table 5 shows the comparison for the multi-group SEMs. We observed metric, but not scalar, invariance in the structural model. This model had acceptable fit (CFI = .956, TLI = .946, RMSEA = .063). Figure 1 shows this final model with scalar measurement invariance and metric structural invariance. As shown, three of four items (burdensome, hopelessness, and fatigue, but not agitation) were associated with SI across samples.

Discussion

We tested the construct validity of SI using two approaches. First, using a measurement model, we tested the coherence of items reflecting SI across three samples; and second, using a structural model, we examined how the SI factor related to agitation, burdensome, hopelessness, and fatigue. Our novel goal was to examine the correspondence of these profiles across sampling and measurement approaches. That is, we tested similarities in three samples that varied in SI severity, demographic characteristics, item wording, self-report

versus interview format, and the time period captured. Demonstration of generalizability across these varied methodological approaches innovatively supports the construct validity of SI broadly.

In our measurement model, we obtained evidence for scalar invariance—suggesting that factor loadings and intercepts were invariant across samples. These three indicators of SI—diminished wish to live, urges to die/controllability, and suicidal intent/expectations—performed similarly across three diverse samples, such that they showed a unifactorial structure, similar factor loadings, and similar profiles of endorsement level. As one might expect given the major differences in methods, residual variances did differ by sample meaning more measurement error associated with one form of assessment than another. Moreover, it could have been related to the non-independence of cases, since we had four cases per participant from Study 3.

Our structural model indicated a parallel factor structure and parallel correlations with related constructs across the three samples. Namely, across samples, hopeless showed strong correlations with SI, whereas burdensome and fatigue showed more modest effects. Agitation was not significantly correlated with SI. Agitation has been shown to be positively associated with suicide attempts (Rogers et al., 2016) and is part of the diagnostic criteria for Acute Suicidal Affective Disturbance (ASAD; Tucker et al., 2016; Rogers et al., 2019), so it may be that agitation is more relevant to suicidal behavior than to SI. Consistent with the differential recruitment sources and severity of the samples, intercepts varied across the samples.

The current findings extend previous work on the validity of SI measures and indicate that items arising from theoretical core facets of SI show parallel performance across remarkably different formats. That is, such items may reflect a coherent phenomenon that is not an artifact of specific item wording, sample severity, demographics, or measurement approaches. However, participants in all three samples were inpatients, thus our findings may not generalize to other clinical or non-clinical populations.

Despite the promise of these findings, existing data limited the items we could consider. Ideally, future research would include a broader range of SI items, such as a desire to die by suicide, presence of suicidal images, acceptance/attitudes toward suicide (e.g., “Suicide is the only way to end this pain”; Rudd & Bryan, 2021), and characteristics of SI including perseveration, intensity, volatility, and chronicity. Additionally, consideration is needed regarding whether preparation for suicide is a distinct dimension of SI (Brown, 2001).

We were also unable to evaluate concurrent and discriminant validity more broadly. Constructs from several theoretical models, such as the integrated motivational-volitional model of suicidal behavior (O’Connor & Kirtley, 2018), highlight defeat, entrapment, and thwarted belongingness, to name a few, as particularly relevant to the emergence of SI, while impulsivity and capability for suicide (e.g., access to means, fearlessness of death) are viewed as more central to suicidal behaviors. Unfortunately, items related to these constructs were not available across the three samples.

For some time, suicide research has placed major emphasis on the prediction of behavior. This has come at the cost of less focus on SI—a troubling indicator of distress that is far more common, responds differentially to treatment, and is a prominent concern in clinical settings. If we were better at identifying and treating SI upstream, we may prevent suicide attempts and deaths downstream. Our hope is that by providing a new level of validity to SI, we can foster greater scientific focus on SI as an entity and increase attention to the complexity and diversity of this apparently coherent phenomenon.

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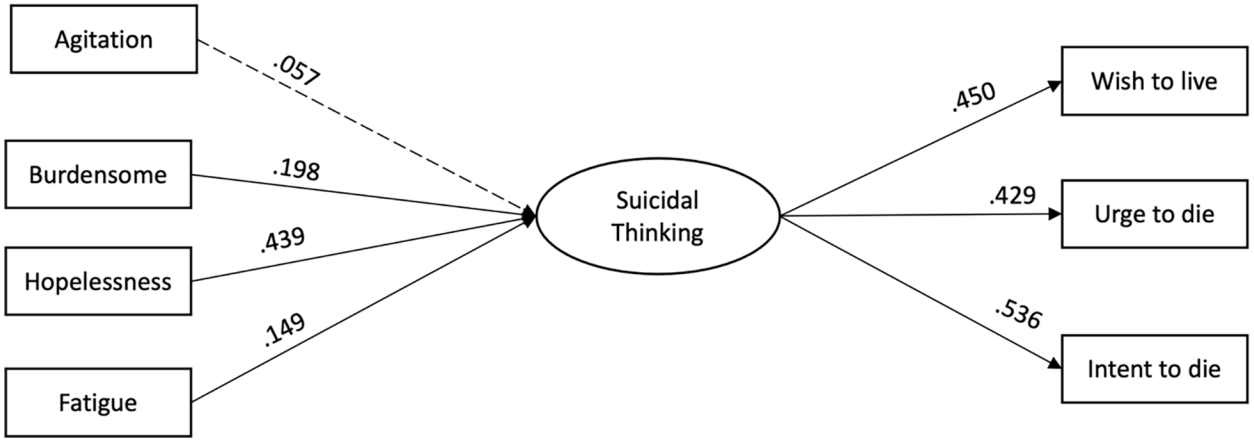

Figure 1.

SEM Showing Measurement Model with Scalar Invariance and Structural Model with Metric Invariance

Note. Solid lines indicate $p < .01$. Covariances (all $p < .001$) are not shown to improve clarity.

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Table 1

Demographic and Clinical Information for Three Studies

Demographic Variable	Study 1	Study 2	Study 3	F/χ^2/t	P
Age (*M*∓*SD*)	37.05∓12.56a	42.54∓12.75b	33.48∓13.84a	8.02	<.001
Male (%)	55%a	79%b	44%a	19.45	<.001
White/Caucasian (%)	59%a	37%b	64%a	6.81	.033
Black/African American (%)	39%a	48%a	8%b	15.36	<.001
Asian (%)	2%a	1%a	20%b	19.37	<.001
Another/Multiple Race(s) (%)	9%	12%	8%	0.95	.623
Hispanic/Latinx (%)	6%a	32%b	16%a	42.02	<.001
Current SI (*M*∓*SD*)	10.49∓10.13a	24.2∓5.71b	N/A	13.10	<.001
History of suicide attempt (%)	$58\%_a$	75%b	N/A	11.66	.003
Multiple attempts (*M*∓*SD*)	$2.16∓2.15_a$	2.74∓1.94b	N/A	2.30	.022

Note. SI = suicidal ideation (measured using the *Beck Scale for Suicidal Ideation* in Study 1 or *Scale for Suicidal Ideation* in Study 2).

Different subscripts across each row mean groups are significantly different in post-hoc test.

Table 2

SI and Related Items and Means for Three Studies

Variable (min-max feature scaled)	Study 1	Study 2	Study 3	F	P
Diminished wish to live	BSS item 1	SSI item 1	"ability to resist the urge to die by suicide"		
	0.42a	0.66b	0.24c	5.69 <	.001
Urge to die	BSS item 9	SSI item 9	"urge to die by suicide"		
	0.31a	0.61b	0.11c	62.23	<.001
Intent to die	BSS item 15	SSI item 15	"intent to die by suicide"		
	0.39a	0.75b	0.10c	125.6	<.001
Agitated	BDI item 11	BDI item 11	"agitated"		
	0.50a	0.42a	0.25b	19.17	<.001
Burdensome	INQ item 6	BDI item 7	"burdensome"		
	0.59a	0.61a	0.32b	29.59	<.001
Hopeless	BDI item 2	BDI item 2	"hopeless"		
	0.54a	0.51a	0.34b	12.24	<.001
Fatigued	BDI item 16	BDI item 16	"fatigued"		
	0.58a	0.63a	0.33b	29.20	< .001

Note. BSS = *Beck Scale for Suicidal Ideation.* SSI = *Scale for Suicidal Ideation.* BDI = *Beck Depression Inventory-2nd edition.* INQ = *Interpersonal Needs Questionnaire.* BSS/SSI item 1 = "wish to live". BSS/SSI item 9 = "ability to keep oneself from dying by suicide". BSS/SSI item 15 = "expectancy of making a future suicide attempt". BDI item 11 = "I feel irritated all the time now". INQ item 6 = "These days I think I make things worse for the people in my life". BDI item 7 = "I am disappointed in myself". BDI item 2 = ("I feel that the future is hopeless and that things cannot improve". BDI item 16 = "I don't sleep as well as I used to". Different subscripts across each row mean groups are significantly different in post-hoc test.

Table 3

Correlations Across Studies

Entire Sample						
	Wish to live	**Urge to die**	**Intent to die**	**Agitation**	**Burdensome**	**Hopelessness**
Urge to die	**.49**					
Intent to die	**.52**	**.56**				
Agitation	**.27**	**.26**	**.25**			
Burdensome	**.34**	**.40**	**.41**	**.33**		
Hopelessness	**.32**	**.34**	**.37**	**.42**	**.49**	
Fatigue	**.24**	**.34**	**.39**	**.28**	**.45**	**.41**
Study 1						
	Wish to live	Urge to die	Intent to die	Agitation	Burdensome	Hopelessness
Urge to die	**.45**					
Intent to die	**.42**	**.65**				
Agitation	**.27**	.14	**.27**			
Burdensome	**.26**	**.26**	**.24**	.18		
Hopelessness	**.25**	**.25**	**.38**	**.39**	**.2**	
Fatigue	.03	.11	.19	.16	**.23**	**.25**
Study 2						
	Wish to live	Urge to die	Intent to die	Agitation	Burdensome	Hopelessness
Urge to die	**.26**					
Intent to die	**.27**	.09				
Agitation	.16	.18	.02			
Burdensome	**.23**	**.19**	**.23**	.13		
Hopelessness	**.31**	.18	**.21**	**.21**	**.59**	
Fatigue	**.19**	.16	.16	.18	**.36**	**.39**
Study 3						
	Wish to live	Urge to die	Intent to die	Agitation	Burdensome	Hopelessness
Urge to die	**.30**					
Intent to die	.20	**.65**				

Entire Sample						
	Wish to live	**Urge to die**	**Intent to die**	**Agitation**	**Burdensome**	**Hopelessness**
Agitation	**.22**	**.43**	**.30**			
Burdensome	.15	**.64**	**.43**	**.49**		
Hopelessness	.20	**.71**	**.58**	**.57**	**.58**	
Fatigue	.01	**.54**	**.41**	**.25**	**.52**	**.44**

Note. Bolded correlations significant at $p < .05$.

Table 4

Summary of Measurement Invariance Comparisons for Measurement model

	Model Fit					Model Comparisons				
Invariance	**AIC**	**BIC**	**CFI**	**TLI**	**RMSEA**	**DF**	**DF Diff.**	**χ^2**	**χ^2 Diff.**	**p**
Configural	299.08	400.32	--	--	--	0	--			
Metric	296.27	382.51	.992	.983	.053	4	4	5.18	5.18	.269
Scalar	295.86	367.10	.969	.965	.076	8	4	12.77	7.59	.108
Strict	432.50	481.23	.046	.387	.317	14	6	161.41	148.64	**< .0001**

Table 5

Summary of Measurement Invariance Comparisons for Structural Model

	Model Fit					Model Comparisons				
Invariance	**AIC**	**BIC**	**CFI**	**TLI**	**RMSEA**	**DF**	**DF Diff.**	**χ^2**	**χ^2 Diff.**	**p**
Scalar MI + Configural	573.58	847.29	.966	.933	.071	32		48.81		
Scalar MI + Metric	558.65	757.37	.956	.946	.063	52	20	73.88	25.070	.198
Scalar MI + Scalar	642.19	810.19	.771	.760	.134	60	8	**173.42**	**99.54**	**< .0001**